Testing the Generalizability of the ISO Model for Nursing Diagnoses

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ABSTRACT

The purpose of this study was to explore whether the ISO reference terminology model for nursing diagnoses could be generalized to the MDS data set that, like nursing terminologies standardizes expressions of the concepts within and relevant to the domain of nursing practice. We first constructed paraphrased expressions of the rubrics from the data set. Next we dissected those expressions into the reference model domains of focus and judgment, recorded any qualifiers required for either domain, and semantic links required to represent associative relations. Our findings demonstrate that the ISO model for nursing diagnoses is generalizable to the MDS data set, however expansions to the model are required if the model is to be used to represent objects rather than terms.

INTRODUCTION

Uniform standards for encoding clinical data provide key infrastructure in support of interoperable data within patient medical record information (PMRI) systems (1,2). Among the challenges in developing reference terminologies that meet such standards is reconciling the demands for re-use of data with the need for common standards. Use-specific coding systems are presently the norm, although mapping across such systems is not a feasible alternative (3). Rather, the development of concept oriented, formally expressed terminologies that enable the composition of semantically well-defined, complex expressions based on primitive concepts is recognized as essential for achieving the goal of re-use of data across PMRI applications and systems (e.g.,

clinical decision support, quality improvements, and resource allocation).

Characteristics of terminologies that enable data sharing and re-use are described (4,5,6). Essentially, the requirements point to a need for terms and their synonyms that are associated with explicitly defined primitive concepts, a formalism that enables that algorithmic composition of complex expressions from primitive concepts, and a model that provides the structure for organizing and associating the concepts.

Several studies have demonstrated the potential utility and feasibility of a reference terminology for integrating concepts from multiple nursing terminologies (8,9). The ISO proposal for a reference terminology model for nursing (ISO/TC 215/WG3/ CD 18104), sponsored by a Nursing Special Interest Group of the International Medical Informatics Association and the International Council of Nurses, is the focus of this study (10).

The purpose of this study was to test the generalizability of the ISO model for nursing diagnoses for the Minimum Data Set (MDS) on which the Centers for Medicare and Medicaid Services (CMS) base prospective reimbursement, quality monitoring, and reporting for skilled nursing facilities (SNFs). Although the MDS was not developed as a terminology, like nursing diagnoses it provides a controlled set of terms that are used to standardize expressions of needs for nursing care. Therefore, it would be extremely useful if a reference model could accommodate MDS

expressions as well as nursing diagnosis expressions.

BACKGROUND

ISO Terminology Model
The goal underlying the development of the ISO reference terminology models for nursing was to develop a common framework to support mapping across the multiple interface terminologies used at the point of care (11). To communicate effectively, a mechanism is needed to translate between terminologies. One way of dealing with this is through the development of terminologies that are concept-based and formally expressed. The challenge facing developers of reference terminologies is integrating terms from disparate interface terminologies and other coding systems into a logically consistent classification that serves as a reference terminology model. Classifications reflect the conceptual structure of a domain and represent the way we organize our knowledge. They are important in developing computer-based systems because the rules with which we classify concepts underlie the ways we construct the algorithms that enable the storage and retrieval of data in order to compose complex expressions from more primitive concepts.

Accordingly, a classification model on which to build a reference terminology for nursing has been seen as a priority. Two reference terminology models have been put forward by ISO, one for nursing diagnoses and one for nursing actions; the nursing diagnosis model is the focus of this paper. ISO models are said to "represent semantic definitions of nursing concepts and the semantic relationships between core concepts and essential attributes or properties" (10). The key components of the nursing diagnosis model include the five domains of focus, judgment, dimension site, and subject of information. Focus and judgment both required for specifying a nursing diagnosis. Focus has semantic categories including property, process, structure, and state and the domain of judgment has semantic categories including alteration, adequacy, altered process, altered state, altered structure. Semantic links provide a way to associate between and among categories and domains.

The ISO model for nursing diagnoses has been shown to be complete for both NANDA nursing diagnoses and Omaha term phrases (7).

Nursing Practice
For over twenty years, the American Nurses Association (ANA) has defined nursing as the "diagnosis and treatment of human responses to actual or potential health problems". A recently revised ANA social policy statement indicates an expanded perspective with four "essential features of nursing practice" identified (11)

- Attention to the full range of human experiences and responses to health and illness without restriction to a problem-focused orientation,
- Integration of objective data with knowledge gained from an understanding of the patient or group's subjective experience
- Application of scientific knowledge to the process of diagnosis and treatment
- Provision of a caring relationship that facilitates health and healing.

The focus of the terminologies that are recognized by the ANA as reflecting nursing practice have emphasized goals, diagnoses, interventions, and nurse-sensitive outcomes. Widespread adoption of these terminologies is not yet evident, although there are indications that they are increasingly being considered for use, particularly in PMRI systems. The development of a reference terminology for nursing would likely enhance this development. It would be extremely useful if the ISO model could also serve as a foundation for other coding systems (e.g., MDS) that similarly reflect key features of nursing practice.

MDS
The Minimum Data Set (MDS) was developed as a result of a long-standing concern among consumers, providers of care, policy makers, and payers over the quality of care in skilled nursing facilities (SNFs). In 1986 the Institute of Medicine published recommendations on ways to improve the regulation of nursing homes to improve quality of care (12). A core theme that emerged was the need to standardize assessment and care planning for nursing home residents.

Congress subsequently passed a law in 1987 that required the development of an assessment form (the MDS) to ensure that each nursing home resident receives, at regular specified intervals, a comprehensive assessment and care plan designed to meet his/her needs. CMS developed the MDS based on input from various disciplines on the information needed for assessment and care planning.

Thirteen domain areas are included in the MDS assessment: past medical history and medically defined conditions, medical status, functional status, physical and sensory impairments, nutritional status, special treatments or procedures, psychosocial status, discharge potential, dental condition, activities potential, rehabilitation potential, cognition, and drug therapy (34). Nationwide collection of the MDS began in the 1990s. The MDS is required by statute to be completed shortly after admission and quarterly thereafter. It is also required upon a significant change in the resident's condition. In most states, a shorter form is used for quarterly assessments than for the more comprehensive admission and annual assessments.

In addition to care planning, MDS data are also used as the basis of the prospective payment rates for skilled nursing facilities (SNFs). A number of states also use an MDS form to adjust Medicaid facility payment rates. Yet another use of MDS data are the quality indicators and quality measures of SNFs posted on the web, intended for consumer use in selecting facilities. These indicators and measures are derived from MDS data. Unfortunately, a disconnect exists between what providers record in clinical documentation systems and reporting requirements such as those put forward by agencies such as CMS although there is great overlap in the clinical concepts expressed in both document structures.

METHODS
Research Questions
1. What percentage of paraphrased MDS items can be fully expressed using the ISO models?

2. What extensions to the ISO model would enable all items to be fully expressed?
3. Which ISO domains (focus, judgment, target, and action) are most often required to express MDS items?

Procedures
Because the format of the MDS data collection form is complex, we first paraphrased the rubrics of the MDS in order to eliminate ambiguities associated with out-of-context data. As an example, within the section of the MDS that concerns "physical functioning and structural problems" is an item that concerns "BED MOBILITY: how resident moves to and from lying position, turns side to side, and positions body while in bed". Two responses are required in relation to this item. The first indicates self-performance, and includes six values ranging from "independent: no help or oversight or help/oversight provided only 1 or 2 times during last 7 days" to "total dependence: full staff performance of activity during entire 7 days" and "activity did not occur during entire 7 days". The second response indicates support provided, and includes five values ranging from "no setup or physical help from staff" to "two + persons physical assist" and "activity did not occur during entire 7 days". A paraphrase of one value for the second response reads as "Two+ persons physical assist provided to support bed mobility (how resident moves to and from lying position, turns side to side, and positions body while in bed) during last 7 days". One investigator independently constructed the paraphrases (MH) and two investigators (HK, LR) independently reviewed the paraphrases to determine whether the paraphrased term accurately represented the intent and meaning of the items, responses, and values on the MDS form. There was overall agreement on 98.5% of the paraphrased terms, and the investigators met to jointly resolve the phrases that seemed potentially unclear. The final number of paraphrased terms in this study was 697.

We then proceeded to dissect the paraphrased MDS items into the following components of the ISO model: Focus Domain, Focus qualifiers, Semantic links, Judgment Domain, Judgment qualifiers, and Semantic links. We

deliberately retained the exact words used in the MDS document in order to analyze them against the semantic categories of the ISO model. Three investigators (MH, HK, LR) jointly evaluated and resolved discrepancies in the dissections.

RESULTS

All of the paraphrased MDS items could be expressed using the ISO model, however we did find some expressions where the model was not sufficient to avoid ambiguity. For example, weight change is a focus of two different domains within the MDS. In one, the meaning of the weight change is an indicator of fluid status, and in another the meaning of weight change is an indicator of nutritional status. A method for formally expressing where a concept resides within a hierarchy would provide a solution to this. This raises the question of whether the model is intended to represent terms or objects, a clarification not evident in the documentation that accompanies the model.

The focus of the MDS is on observations of residents, and on determinations of "problems" or "status". As such the focus and judgments required to represent the MDS expressions often concern notions of ability, capacity, performance, impairments, limitations, and dependence. We were not able to sort such terms into the semantic categories of the ISO model. Of note, these are in fact components within the WHO's International Classification of Functioning and Disability. This raises the interesting possibility that adding semantic classes from other coding systems to the semantic categories of the ISO model would provide a method to enhance the exchange of data across a range of source coding or classification systems.

The ISO domain of focus was used for 100% of the MDS expressions, however the domain of judgment was only required for approximately 2/3 of the MDS expressions. This difference clearly differentiated expressions that were intended to merely report observations from expressions that were intended to communicate some determination of problem or status. This is similar to the ISO model requirements for the use of both focus and judgment to express nursing diagnoses.

DISCUSSION

The results of this study are encouraging with regard to an important feature of reference terminology models; i.e., providing a unified method for supporting interoperability among various terminology systems and thereby the re-use of data. Achieving such reuse would enable regulatory reporting that concerns clinical data to be *derived* from clinical documentation systems rather than redundant form-filling.

Several issues require further investigation. First, the format of the MDS assessment form was complicated, with many nested notions. There are many different structures for items and responses in the MDS, so no common algorithm was evident. This has the potential to introduce ambiguity to the processing of content encoded within such forms. Since forms provide important structure for data entry as well as data retrieval, it will be important to develop approaches to formally represent the complex expressions that are suggested within the structure of the form. The ISO model does not allow representations of nesting within judgments, rather argues that this is a function to be represented in the information model.

Second, instructions printed on the form can function as conditionals, or constraints on the meaning of the coded data element. For example, the MDS item that asks for a determination of "short-term memory problem" includes the prompt "seems/appears to recall after 5 minutes". In contrast the item that asks for a determination of "long-term memory problem" includes the prompt "seems/appears to recall long past". The condition of 5 minutes clearly provides an important semantic discriminator in the expression of short-term memory compared to long-term memory, and is easily accommodated as the qualifier of timing applied to the focus. In contrast, instructions that direct a comparison to how the status at the time of MDS completion compares to the status at time of last assessment would seem to be better accommodated in an information model.

It is likely that work such as the HL7 templates and clinical document architecture standards that are under development will be helpful in this regard.

Although the purpose of this study was not to evaluate a system for expressing "what nurses do", it is interesting to note that skilled nursing actions are not directly expressed in the MDS. For example, rather than encoding the administration of chemotherapy, the MDS data element only expresses an observation that the resident received chemotherapy. This situation of course reflects the motivation for the development of nursing intervention/action terminologies.

An important area for expansion in the development of the ISO model concerns whether the model is about terms or objects. If the model is about objects, a full specification of concepts represents one way to do this. In particular, identifying the placement of terms/concepts within a hierarchy is critical.

This study demonstrates that the ISO terminology model for nursing diagnoses can be generalized to coding systems other than nursing terminologies. This is an essential requirement for systems supporting reuse of clinical data.

Acknowledgements

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